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Remarks**A. Basis for claim amendments**

Basis for new claim 7 includes Examples 1, 3, 4 and 5 of the specification.

Basis for new claim 8 includes claim 1. Claim 1 calls out "wherein said aqueous glycerol solution has a water content of not more than 20% by weight." Here, where the water content is 20% by weight, then the glycerol to water ratio by mol is 80/92 to 20/18 (or 1 to 1.2), where the value 92 represents the molecular weight of glycerol, where the value 18 represents the molecular weight of water, where the value 80 represents the percent by weight of glycerol and where the value 20 represents the percent by weight of water.

Basis for new claims 9, 10 and 11 includes page 8, lines 4-12 of the specification that provides:

Incidentally, acrylic acid produced by the production process of the present invention can be industrially further subjected to publicly known purification methods ... to thus provide acrylic acid as a product. Then, this product can be used to produce, for example, polyacrylic acids (salts) as water-soluble polymers or water-absorbent resins, by publicly known polymerization methods such as thermal polymerization methods and photopolymerization methods.

B. The Office Action

There are three rejections pending:

1. Claims 1 and 3-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Unverricht et al. (US 6,525,217), in view of Hoyt (US 2,558,520);
2. Claims 1 and 3 are rejected under 35 U.S.C. 103(a) as being unpatentable over Unverricht et al. (US 6,525,217), in view of Hoyt (US 2,558,520), further in view of Unverricht et al. (US 6,403,829); and
3. Claims 1 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Unverricht et al. (US

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6,525,217), in view of Hoyt (US 2,558,520), further in view of Uchida et al. (US 4,871,700).

C. Applicant's discussion

C.1. Claimed difference is present

Claim 1 is as follows:

1. (previously presented) A process for producing acrylic acid, comprising the steps of:
 - a) vaporizing a raw material comprising an aqueous glycerol solution to generate a first gas, wherein said aqueous glycerol solution has a water content of not more than 20% by weight;
 - b) applying a dehydration reaction to glycerol in a gas phase that includes said first gas; and then
 - c) applying a gas phase oxidation reaction to a gaseous reaction product formed by the dehydration reaction to obtain said acrylic acid.

Claim 1 positively recites that the dehydration reaction is conducted in a gas phase. However, in Hoyt, the dehydration reaction is conducted in a liquid phase (in an inert hydrocarbon liquid). Please see, for instance, claim 1 of Hoyt.

It is therefore respectfully submitted that independent claim 1 is allowable over each of the above noted three rejections on the basis of this claimed difference.

C.2. There is no teaching, suggestion or motivation to combine Unverricht et al. with Hoyt

There are a number of reasons why there is no teaching, suggestion or motivation to combine Unverricht et al. with Hoyt. These reasons are set out below.

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C.2.a. The simple liquid phase process of Hoyt results in the generation of tar

A simple liquid phase process results in the generation of a tar and stagnation and accumulation of high-boiling-point impurities in a system and is therefore not suitable for industrial continuous production. The problem of the generation of tar is acknowledged in Hoyt, and Hoyt does not describe eliminating the generation of tar but simply reducing it in column 2, lines 45-50:

It is essential in practicing the present method that the acid or anhydride be supported upon a carrier, since if the acid or anhydride is not so supported the yield of acrolein is poor and excessive tar formation results.

The Hoyt process may be expected to decrease the tar that is generated, but cannot be expected to entirely exclude the generation of tar.

The Hoyt patent also discloses in column 3, lines 6-11 the following:

All of the aforementioned liquids have the necessary characteristics for use in the method of the present invention, viz., a high boiling point, stability at the reaction temperature, and non-reactivity with the glycerol or its decomposition products.

However, even if a solvent does not react with glycerol or a product therefrom, a by-product having a high boiling point which stagnates in a system may react with glycerol or a product therefrom such as acrolein, thus causing the formation of tar or the reduction of yield.

C.2.b. Primary reference does not teach starting material; secondary reference is cited to cure primary reference

Applicant's first step is:

- glycerol to a gaseous reaction product (acrolein).

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Applicant's second step is:

- gaseous reaction product (acrolein) to acrylic acid.

The Patent Office employs Unverricht et al. '217 (and its teaching of the petroleum product of propene) as the primary reference against applicant's first and second steps. The Patent Office then employs the secondary reference Hoyt (and its teaching of glycerol) to cure the first step.

"Starting from propene" is an indispensable part of the Unverricht et al. process. One skilled in the art would not destroy an indispensable part of the primary reference to employ the combination of Unverricht et al. '217 (starting material of propene) and Hoyt (starting material glycerol).

C.2.c. A substance diffuses at a greater speed in a gas phase than a liquid phase; therefore a liquid phase is unlike a gas phase

In the interview of May 20, 2008, the Examiners pointed out a portion of the top of column 2 of the Hoyt reference. This portion reads: "The temperature at the top of the fractionating column was maintained at a point such that vaporized oil was returned to the container."

As pointed out by the Examiners in the interview, a part of the solvent may be vaporized in Hoyt. However, the reaction itself takes place in a liquid phase.

It is widely known to a skilled artisan that there is a great difference between a liquid phase and a gas phase as to the speed at which a substance diffuses in a reactor, so that there is also a great difference as to necessary properties of such as catalysts. Therefore, except for only a few examples, a replacement of a liquid phase reaction by a gas phase reaction or otherwise a

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replacement of a gas phase reaction by a liquid phase reaction is usually not carried out.

C.2.d. Taking to the next step the argument of the Examiners that it is relevant that Hoyt discloses a gas

As indicated in the section above, the Examiners assert that Hoyt is applicable for its disclosure as to "The temperature at the top of the fractionating column was maintained at a point such that vaporized oil was returned to the container." This disclosure of Hoyt is taken a step further.

Again, Hoyt discloses that a gas of a hydrocarbon solvent is generated. However, if this hydrocarbon solvent gas came into a second reactor (where a gas phase oxidation reaction of acrolein to acrylic acid is carried out), then there would be problems as to:

1. the hydrocarbon solvent gas being adsorbed into or onto a catalyst, thereby deactivating the catalyst or clogging the reaction tube, or
2. the hydrocarbon solvent gas undergoing combustion to consume oxygen, thereby causing a shortage of oxygen necessary for the oxidation reaction of acrolein, or
3. the combustion of the hydrocarbon solvent gas causing abnormal heat generation, thereby damaging the catalyst or reactor, or
4. the hydrocarbon solvent gas mingling into a formed acrylic acid gas, thereby damaging the purification step of acrylic acid.

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C.2.e. Hoyt discloses octadecane and Unverricht discloses oxygen; the product of such a combination would be ignition

The Hoyt reference discloses the employment of "octadecane" in column 3, line 4. Octadecane is known to have a flash point of about 165 °C.

Unverricht '217 discloses, as for example in the abstract, that when acrylic acid is produced from acrolein, the production is carried out by a gas phase oxidation reaction under the coexistence of oxygen.

If a hydrocarbon solvent such as octadecane is mixed with oxygen, ignition is a likely result. This teaches away from the combination of Hoyt and Unverricht '217.

Therefore, the combination of Hoyt with Unverricht '217 needs complicated arrangements such as: the dehydration reaction of glycerol being carried out in the absence of oxygen and, after the mingling hydrocarbon solvent gas has been completely removed, acrylic acid being produced from an acrolein gas having been mixed with an oxygen-containing gas. Thus, the simple combination of Hoyt with Unverricht '217 cannot industrially be carried out.

C.2.f. Summary

In light of the reasons discussed in the above sections, it is respectfully submitted that there is no teaching, suggestion or motivation for combining Hoyt with Unverricht '217.

C.3. Unexpected advantages

Generally, this case relates to the steps of (1) acrolein being obtained from glycerol and (2) acrylic acid being obtained from acrolein.

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In the first step cited above, ally alcohol is formed in the dehydration reaction of glycerol in a gas phase. Then, in the second step cited above, the formed ally alcohol is converted into acrylic acid. This formation and conversion of ally alcohol is presently thought to be one of reasons for the high yield of acrylic acid in the present invention. This formation and conversion mechanism was unknown by the inventors at the time of the convention priority date (January 30, 2004) of this case.

If acrolein is prepared from glycerol in the way of the combination of Hoyt and Unverricht and thereafter used to produce acrylic acid, then at least a part of the above ally alcohol is unfavorably removed, so that the total yield of acrylic acid from glycerol is unfavorably lessened. However, if the product of the dehydration reaction of glycerol is directly subjected to the oxidation reaction as in the present invention, then acrylic acid is efficiently obtained.

D. Housekeeping matters

D.1. Period For Reply

A shortened statutory period for reply was set to expire three months from the mailing date of the Office Action of April 2, 2008. April 2, 2008 plus three months is July 2, 2008. This Amendment and Remarks is being filed on or before Wednesday, July 2, 2008.

D.2. Status

The Office Action of April 2, 2008 was nonfinal.

D.3. Disposition Of Claims

Claims 1 and 3-11 are pending.

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D.4. Application Papers

This case includes no drawings.

D.5. Priority under 35 U.S.C. §§ 119 and 120

Acknowledgement of the claim for foreign priority was made in the Office Action dated May 24, 2007. This is appreciated.

D.6. Attachments

As the Examiner has indicated, applicant has filed one PTO-1449 form in this case. This form has been initialed, signed and returned. This is very much appreciated.

D.7. Statement of Substance of Interview

Examiners Cho and Eyler kindly granted a phone interview to the undersigned on May 20, 2008. This phone interview was very much appreciated.

In the interview, the Hoyt and Unverricht references were discussed. Claim 1 and its limitation as to gas phase was discussed. Dependent claims 7 and 8 were discussed. Claims 9-11 were discussed. It is the understanding of the undersigned that the Examiners said that claims 9 and 10 may be nonstatutory and that claims 9-11 may be restricted out of the case. The Examiners suggested that the filing of arguments, relating to why the references of Hoyt and Unverricht may not be combined, may be helpful to advance prosecution.

D.8. As to claims 9-11

It would be very much appreciated if the Examiner could point out specific objections to claims 9-11 in the subsequent Office Action. For example, it would be

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appreciated if the Examiners could discuss why claims 9-10 are nonstatutory and why claims 9-11 would be restricted out.

E. Summary

Applicant respectfully submits that the present application is now in condition for allowance. The Examiner is respectfully invited to make contact with the undersigned by telephone if such would advance prosecution of this case.

Respectfully submitted,

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